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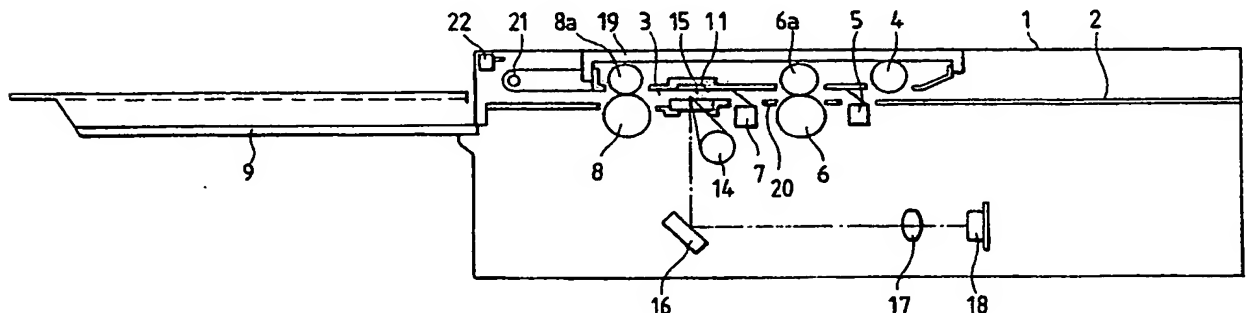
54 An image reading apparatus.

57 There is disclosed an image reading apparatus for photoelectrically reading an image used for facsimile apparatus, digital copying machines, etc.

The image reading apparatus includes a reading unit for reading an image on an original at a reading position, a reference member provided at the read-

ing position, a memory unit for storing reference data obtained by reading the reference member with the reading unit, a discriminating unit for discriminating whether or not the original exists at the reading position and a control unit for causing the memory unit to store the reference data.

FIG. 1



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BEST AVAILABLE COPY

## BACKGROUND OF THE INVENTION

### Field of the Invention

The present invention relates to an image reading apparatus for photoelectrically reading an image used for facsimile apparatus, digital copying machines, etc.

### Related Background Art

An image reading apparatus, which converts an image into an electric signal for output, is used in order to transmit to a remote place and store an image on an original document.

Such an image reading apparatus is generally so constructed that an image on an original document to be read is transferred from a specified loading position to a reading position, the image on the original document is exposed by a light source such as a fluorescent lamp at the reading position, and a reflected light from the original document is converted into an electric signal by an image sensor such as a CCD line sensor.

Also in the image reading apparatus, an electrical process of shading correction is performed to remove an ununiform level in an image signal which is caused by an ununiform quantity of light from a light source, ununiform sensitivity of the image sensor and characteristics of an optical system such as a lens and a mirror.

To perform shading correction for a read signal in an image reading apparatus, a light volume distribution data for the above light source has been conventionally sampled. For this light volume distribution data, a reference plane, which is a white ground, provided near a reading position is read in accordance with a detection that an original document has reached before the reading position prior to reading an image on the original document, and a read data on the reference plane is used. When a plurality of original documents are automatically fed continuously, the current position of the original document is checked to read the above reference plane immediately before each original document is fed to the reading position.

When, however, an oblique original has been conveyed or an original at an angle, detection of the position to sample a data for the above-mentioned shading correction has been delayed and as a result, there was a defect in a conventional apparatus that one part of the end of the original is erroneously read as the reference plane.

To eliminate such a defect, it may be considered to greatly delay the timing for sampling the light volume distribution data from the reference plane and the timing of arriving at the reading position for original documents by prolonging the

conveyance interval of a plurality of original documents. In this case, however, a new defect occurs that it will take more time to read the entire plurality of original documents.

The present applicants have proposed in U.S. P. No. 4,717,963 and U.S. P. No. 4,870,501 a configuration whereby shading correction is performed for an image read data in accordance with the presence of an original at a reading position.

In these applications, however, the presence of an original at a reading position is detected by using sensors such as a microswitch.

## SUMMARY OF THE INVENTION

Thus, it is an object of the present invention to provide an image reading apparatus capable of satisfactorily reading an image on an original document.

It is a further object of the present invention to provide an image reading apparatus capable of reading a good image for an original document itself even if a portion of the original document is read in a timing for obtaining a data for correction without delaying a reading time for the fed original document.

It is also an object of the present invention to provide an image reading apparatus which does not require ceasing from reading an image, but is capable of continuing to read the image, and does not deteriorate the read image for the original document even if a data for correction cannot be obtained due to improper conveyance of the original document.

It is another object of the present invention to provide an image reading apparatus capable of controlling in accordance with the presence of an original document at a reading position without necessitating providing an exclusive sensor for detecting the presence of the original document.

The above-mentioned and other objects and effects of the present invention will appear more fully from the following description.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a configuration of an image reading apparatus according to the present invention.

Fig. 2 is a block diagram showing a configuration concerning shading correction.

Fig. 3 is a block diagram showing a concrete circuit configuration.

Fig. 4 is a flow chart showing a control procedure to be executed by a CPU 32 in Fig. 3.

Figs. 5A to 5C are explanatory drawings showing a state of conveyance of an original document.

Figs. 6A to 6C are wave form charts showing a signal wave form of an image data obtained by

coping with a state of conveyance of an original document in Figs. 5A to 5C.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will hereinafter be described in detail referring to preferred embodiments.

Fig. 1 is a block diagram showing a configuration of an image reading apparatus according to the present invention.

In Fig. 1, numeral 1 is the apparatus main body, numeral 2 is an original loading stand, and a conveyance path 3 for an original document in cut sheet is formed on their extension line. Along this conveyance path 3, the following are disposed in order from the upstream side: a pick-up roller 4 for conveying an original document in cut sheet, a microswitch 5 which operates with a minute force to detect the presence of the sheet original, a pair of conveyor rollers 6 and 6a, a microswitch 7 which operates with a minute force to detect the front and rear ends of the original, a pair of conveyance rollers 8 and 8a, and an exhaust paper tray 9 for the sheet original.

A fluorescent lamp 14, a light source for lighting an original, irradiates an original conveyed to a reading position 15, and its reflected light is input into a solid image pickup element (CCD) 18 consisting of a plurality of light receiving elements, which have been linearly arranged, through a mirror 16 and a lens 17 to read an image on the original for each line for scanning. An uniform white reference plane 11 is provided at the reading position 15.

The conveyance path 3 is composed of a guide unit 19 and a guide member 20, and is so constructed that it can be opened above at the reading position 15 for the original. That is, the guide unit 19 is rotatably mounted round a fulcrum 21 on the apparatus main body, and opening the conveyance path 3 turns on a microswitch 22 to allow the opening of the conveyance path 3 to be detected.

The operation of an image reading apparatus constructed as mentioned above will be described.

While the guide unit 19 is closed, that is, the conveyance path 3 is closed, place one or a plurality of sheet originals 23 on the original loading stand 2, and operate a start switch provided at a console, and then the presence of the sheet original will be detected by the microswitch 5. When the sheet original is detected by the microswitch 5, a solenoid is turned on, and the pickup roller is pressed against the sheet original to convey it in the left direction.

The front end of the lowest one of a plurality of

sheet originals is held between the conveyance rollers 6 and 6a, and when the sheet original is detected by the microswitch 7, the solenoid is turned off to release the pressing force on the pickup roller 4.

When the solenoid is turned off and the pressing force on the pickup roller 4 is released, the above-mentioned driving motor is driven for SA step to convey the sheet original only for a distance A between the microswitch 7 and the reading position 15. When the front end of the sheet original reaches the reading position 15, reading of the original image starts. When the fluorescent lamp 14 lights the sheet original and its reflected light forms an image on the CCD 18 through the mirror 16 and the lens 17, the reading is performed by converting the image into an electric signal for each line by means of the CCD 18.

When the rear end of the sheet original reaches the reading position 15 to complete reading thereafter, the motor is driven only for a number of steps, SB, equivalent to a distance B between the reading position 15 and the conveyance rollers 8 and 8a to exhaust the sheet original onto the tray 9. The reading operation for the sheet original is now completed.

Fig. 2 shows a basic configuration concerning shading correction for an image reading apparatus shown in Fig. 1.

In an image reading apparatus according to an embodiment of the present invention, a white ground image on a reference plane 11 provided beforehand is read, and shading correction is performed using the read image data before reading the original image.

In Fig. 2, memory means 100 stores the abovementioned read image data for one line for shading correction.

Determination means 200 compares and determines whether or not more than a predetermined number of black pixel data exist in the abovementioned read image data for one line.

When the determination result of the determination means 200 is affirmative, control means 300 inhibits update memory of the read image data into the memory means 100. When the determination result of the determination means 200 is negative, control means 300 permits update memory of the read image data into the memory means 100.

Correction means 100 performs shading correction for a read image signal for original image in accordance with an image data for shading correction stored in the above memory means 100.

Fig. 3 shows a concrete circuit configuration according to an embodiment of the present invention.

An image signal photoelectrically converted by the solid image pickup element (CCD) 18 is input

into a control unit 30 and correction circuit 60 after converted into a digital signal by an analog-digital (A/D) converter 50.

The control unit 30 controls a driving mechanism 40 to control the movement of an original, turning on and off of a light source (a fluorescent lamp 14), conveyance of the original and the like for reading scan of the CCD 18.

The detailed description of the driving mechanism 40 is omitted because a conventional, well-known mechanism can be used.

In the control unit 30, an input buffer 31, a central processing unit (CPU), a random access memory (RAM) 33, a read-only memory (ROM) 34, and an interface (I/O) 35 to 37 are commonly connected to a bus 38.

An input buffer 31 receives a read data from the CCD 18 through the A/D converter 20 to temporarily store a data for one line. This read data is a white ground image on a reference plane 11 for shading correction.

The CPU 32 processes the following in addition to controlling the entire apparatus.

1) The CPU 32 transfers a read data of CCD 18 for the reference plane 11 of CCD 10 to RAM 34 through the input buffer 31 to correct shading, and hereafter performs shading correction using this image data. At this time, the CPU 32 determines the presence of the end of an original to decide whether or not the read data has been stored in the RAM 34. Accordingly, RAM 34 operates as memory means 100 in Fig. 2, and CPU 32 operates as determination means 200 and control means 300.

2) In the same way as in a conventional example, the CPU 32 gives an operation instruction to the driving mechanism 40 in accordance with an input from the console 80 and a sensor group 70, conveys the original and reads the image to output the read image data to the outside.

A RAM 33 stores, for retention, a read image data for shading correction, a general operation result of the CPU 32 and information on state of operation of the driving mechanism 40 in accordance with a read/write instruction by the CPU 32. Also an image data for shading correction, which has been read out from the RAM 33, is fed into a correction circuit 60, which performs shading correction for an original image data from the A/D converter 50. Accordingly the correction circuit 60 operates as the correction means in Fig. 2.

A ROM 34 has stored beforehand a conventionally wellknown control program whereby the above process is performed by the CPU 32, and the control program in which the control procedure shown in Fig. 4 has been described.

A I/O 36 transfers a signal from the driving mechanism 40 such as a detection signal for posi-

tions of each component and an original to the CPU 32, and a I/O 35 transfers an operation instruction by the CPU 32 such as a motor drive/stop instruction and a light source ON/OFF instruction to the driving mechanism 40.

A I/O 37 transfers a key input signal from a console 80 to the CPU 32, and also transfers a display signal from the CPU 32 to a display of the console 80.

As shown in Figs. 5A to 5C, position sensors 91 and 92 consisting of microswitches 5 and 7 are provided near a reading position x for an original. The position sensor 91 detects the end of an original as object of reading to make sure that the original has been inserted at an original stand-by position. The position sensor 92 detects the presence of an original to be conveyed for reading.

A series of operations to read an original image will be described referring to the flow chart in Fig. 4.

A procedure from step S1 to step S6 in Fig. 4 is the operations from the time the apparatus main body is powered on until a stand-by state is reached. Since the shading correction data in the RAM 33 is uncertain at this time, shading correction data is sampled as an initialization operation.

Step S1 Turn on the power to light the light source.

Step S2 Use the position sensor 92 (See Fig. 5A) to determine whether or not the original remains at the reading position.

Step S3 If it has been determined in the abovementioned step S2 that there exists an original at the reading position, exhaust all originals which have been inserted so far to ensure that there is no original at the reading position.

Step S4 Sample a data for shading correction, and store in the shading area (See Fig. 3) in RAM 33.

Step S5 Put out the light source to put the apparatus in a stand-by state.

Step S6 Continue to watch the position sensor 91 until the original is inserted.

Step S7 to step S10 show a procedure after it is recognized in step S6 that the original has been inserted into the apparatus by the operator, and perform the control process until the first page of the original is read.

Step S7 Discriminate whether or not the original inserted by the operator has already reached the position sensor 92. If the original has already reached the position sensor 92, do not execute the following steps S8 and S9, but proceed to

step S10 because it is not known how far the front end of this original has been inserted.

Step S8 Light the light source, sample a shading correction data to read the first page, store the shading correction data in a shading area of the RAM 33, and thereafter convey the original to the reading position in step S9.

Step S10 Continue the stand-by state until a reading start instruction from the console 80 is given by the operator or a reading start instruction is input from the CPU 32.

In steps S11 to S17, continuous conveyance of a plurality of originals placed on the original loading stand 2 by an automatic original feeding mechanism and continuous reading of plural pages are controlled. Especially, the CPU 32, which executes steps S14 and S15, functions as determination means 200 and control means 300 as shown in Fig. 2.

Step S11 Read one page of the original while conveying the original already at the reading position. At this time, correct an original image data from CCD 18 in a correction circuit 60 using a shading correction data in a shading area of the RAM 33. The completed reading is recognized by reading and conveying a specified amount after the rear end of the original has passed the position sensor 92.

Step S12 Determine whether or not the next original exists by the position sensor 91, and if it has been determined that there exists the next original, proceed to step S13.

Step S13 After the front end of the next original passed the position sensor 92, convey it to a position at a distance of 1 (shorter than a distance to the reading position, See Fig. 5A) so that the front end of the original is located midway between the position sensor 92 and the reading position. At this time, the read previous original is exhausted only for the same distance as for conveyance of the next original.

Step S14 In a state in which there is neither previous original nor next original at the reading position as a result of the process in the above step S13, read a white ground image for one line for shading correction,

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Step S15

Step S16

and store the read data in the test area in the RAM 33. In this example, a reference plane 11 with a uniform density located opposed to the reading position will be read. Count an amount of black pixels included in binary data for one line, which has been read in the above step S14 and stored in the test area of the RAM 33, and determine whether or not the amount is more than a specified amount. If it is a data obtained by reading the above reference plane 11, it is of such an extent as a very small amount of dust on the reading surface that becomes black pixels. If, however, the end of the original is located at the reading position after the original has been conveyed at an angle as shown in Figs. 5B and 5C, the amount of black pixels increases because of a shade, etc. of the original or the end. Accordingly, if it has been determined that the amount of black pixels is less than a specified value, it will be assumed that there is no original at the reading position, but it is possible to read the entire area of the reference plane 11. On the other hand, if it has been determined that the amount of black pixels is more than the specified value, it will be assumed that there is an original and it is impossible to read the entire area of the reference plane 11.

Step S16 If it has been determined in step S15 that the amount of black pixels within the test area of RAM 33 is less than a specified value, read the reference plane 11 for shading correction, sample a read wave form and store it in the shading area of RAM 33 in step S16. On the other hand, if it has been determined in step S15 that the amount of black pixels is more than the specified value, do not execute the above S16, but proceed to step S17. Accordingly, when there is already an original at the reading position, storage of a shading correction data in the shading area of RAM 33 is not updated, but the shading correc-

tion data used for shading correction for the previous original will be held.

Step S17 Convey the next original to the reading position in preparation for the next reading, and return to step S11 again. When the next original goes at an angle as shown in Fig. 5B and even when the previous original goes at an angle as shown in Fig. 5C, read the next original if the original goes at an angle to such a grade that any original jam and omitted reading do not occur.

Step S18 to step S20 are a portion in which a process after the final original has been read is performed.

Step S18 If it has been determined in step S12 that the next original does not exist, completely exhaust the final original.

Step S19 In preparation for the next reading, sample the shading correction data, and store it in the shading area of RAM 33.

Step S20 Put out the light source, and return to the step S6 in a stand-by state.

Execute the above processes, and obtain the read data for shading if it is possible to read the reference plane 11 during conveyance between the original and the next original.

Summarizing these operations, if both a read-original A and an original B as object of reading are conveyed straight as shown in Fig. 5A, there will be no original at the reading position, but such a wave form without black pixel data as shown in Fig. 6A will be obtained as a white ground image data for the reference plane 11.

If, however, an original A as object of reading is at an angle as shown in Fig. 5B, the left end of the original A reaches the reading position x, and in a read wave form (See Fig. 6B) for the reference plane 11, a dent of a black pixel area occurs in an area with the texture color of the original A and the original shady area.

Fig. 5C shows when a read-original B has been conveyed at an angle, and a dent of a black pixel area also occurs in the read wave form as shown in Fig. 6C.

According to an embodiment of the present invention, taking notice of a fact that the read data for shading has no black pixel data when the original has been normally conveyed, when the states of conveyance in Figs. 5B and 5C have been detected from the abnormality in the above read data, do not use this data for shading correction, but use the previously obtained read data as the

shading correction data.

To detect conveyance of an original at an angle, the presence of more than a specified amount of black pixels is made a condition and not the presence of a black pixel. This is because a very small amount of dust, etc. are likely to exist at a reading position and mistaking the end of an original for these should be prevented.

In addition to this embodiment, the following examples are cited.

In the process in the step S15 in Fig. 4 according to an embodiment of the present invention, to stop sampling of a shading correction data, it was made a condition that a number of black pixels in one line reaches a specified amount. If, however, a number of times for occurrence of continuous black pixels in a specified amount is set in addition to this condition, the effect of dust such as minute paper powder on a reading surface may be further reduced.

The above determination condition was applied to a read data for one line, but as another method, there is also a method whereby one line is first read, further another line is read after conveying the original by one line hereafter, and the difference in number of pixels in read data between these two lines is calculated. In this method, an erroneous determination due to dust, etc. on the above reading surface can be avoided because only the state of the original has changed between the first and second lines.

Also the above determination was made on the basis of the number of black pixels in the read data for one line, but it may be made depending upon whether or not the number of white pixels is more than a specified value on the contrary.

As described above, even if a read image data for shading correction is deteriorated due to improper conveyance of an original, etc., the data will not be used, and therefore a read image data from the original will be corrected using the erroneous correction data, and not deteriorated.

The present invention has been described referring to preferred embodiments above, and is not limited to these embodiments, but can, of course, be applied by modifying in various ways within the scope of the Claims.

There is disclosed an image reading apparatus for photoelectrically reading an image used for facsimile apparatus, digital copying machines, etc.

The image reading apparatus includes a reading unit for reading an image on an original at a reading position, a reference member provided at the reading position, a memory unit for storing reference data obtained by reading the reference member with the reading unit, a discriminating unit for discriminating whether or not the original exists at the reading position and a control unit for caus-

ing the memory unit to store the reference data.

### Claims

1. An image reading apparatus, comprising:
  - reading means for reading an image on an original document at a reading position and generating electric data representing the read image;
  - a reference member provided at the reading position;
  - memory means for storing reference data obtained by reading said reference member with said reading means;
  - correcting means for correcting image data obtained by reading the original document with said reading means on the basis of the reference data stored in said memory means;
  - discriminating means for discriminating whether or not the original document exists at the reading position in accordance with the reference data; and
  - control means for causing said memory means to store the reference data, when said discriminating means discriminates that the original document does not exist at the reading position.
2. An apparatus according to Claim 1, wherein said control means causes not to store the reference data, when said discriminating means discriminates that the original document exists at the reading position.
3. An apparatus according to Claim 1, wherein said discriminating means performs the discrimination operation in accordance with an amount of specific data included in the reference data.
4. An apparatus according to Claim 3, wherein the specific data is image data representing a black image.
5. An apparatus according to Claim 1, wherein said correcting means performs a shading correction for the image data.
6. An apparatus according to Claim 1, further comprising feeding means for feeding the original document to the reading position.
7. An apparatus according to Claim 1, wherein said reading means reads the reference member when the original document does not exist at the reading position.
8. An image reading apparatus, comprising:
  - reading means for reading an image of an original document and generating electric data representing the read image;
  - feeding means for feeding a plurality of original documents to the reading position, one by one;
  - a reference member provided at the reading position;
  - memory means for storing reference data obtained by reading said reference member with said reading means, after completion of reading of a preceding original document and before start of reading of a current original document;
  - correcting means for correcting image data obtained by reading respective ones of the plurality of original documents with said reading means, on the basis of the reference data stored in said memory means;
  - discriminating means for discriminating whether or not the original document exists at the reading position in accordance with the reference data; and
  - control means for causing said memory means to store the reference data, when said discriminating means discriminates that the original document does not exist at the reading position.
9. An apparatus according to Claim 8, wherein said control means causes not to store the reference data, when said discriminating means discriminates that the original document exists at the reading position.
10. An apparatus according to Claim 8, wherein said discriminating means performs the discrimination operation in accordance with an amount of specific data included in the reference data.
11. An apparatus according to Claim 10, wherein the specific data is image data representing a black image.
12. An apparatus according to Claim 8, wherein said correcting means performs a shading correction for the image data.
13. An apparatus according to Claim 8, wherein said reading means reads the reference member when the original document does not exist at the reading position.
14. An image reading apparatus, comprising:
  - reading means for reading an image of an original document at a reading position and generating electric data representing the read

image;

a reference member provided at the reading position;

memory means for storing reference data obtained by reading said reference member with said reading means; 5

correcting means for correcting image data obtained by reading the original document with said reading means on the basis of the reference data stored in said memory means; 10

discriminating means for discriminating whether or not an amount of specific data included in the reference data is more than a predetermined amount; and

control means for controlling the storage operation of said memory means in accordance with the discrimination result of said discriminating means. 15

15. An apparatus according to Claim 14, wherein the specific data is image data representing a black image. 20

16. An apparatus according to Claim 15, wherein said control means causes said memory means not to store the reference data, when said discriminating means discriminates that the amount of the specific data is more than the predetermined amount. 25

17. An apparatus according to Claim 14, wherein said correcting means performs a shading correction for the image data. 30

18. An apparatus according to Claim 14, further comprising feeding means for feeding the original document to the reading position. 35

19. An apparatus according to Claim 14, wherein said reading means reads the reference member when the original document does not exist at the reading position. 40

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FIG. 1

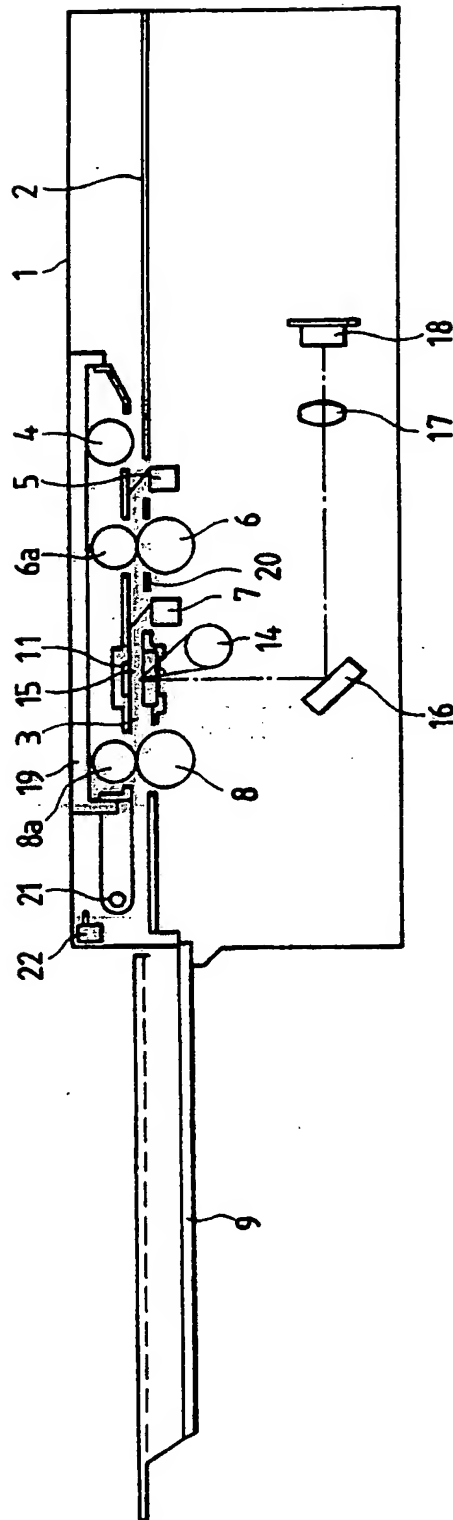


FIG. 2

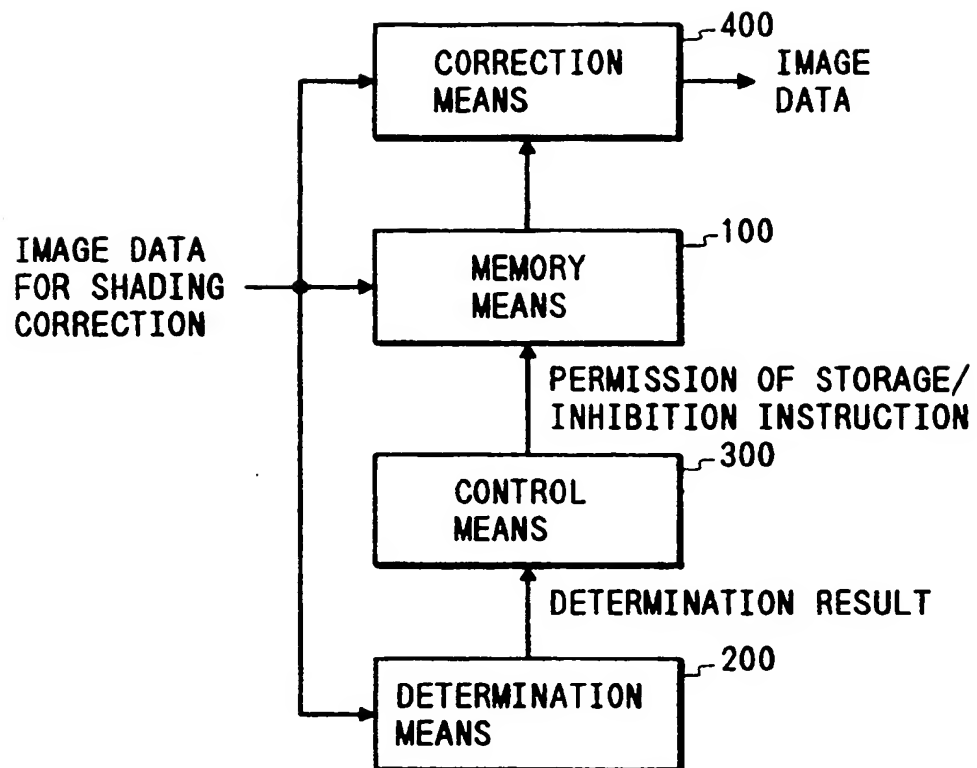


FIG. 3

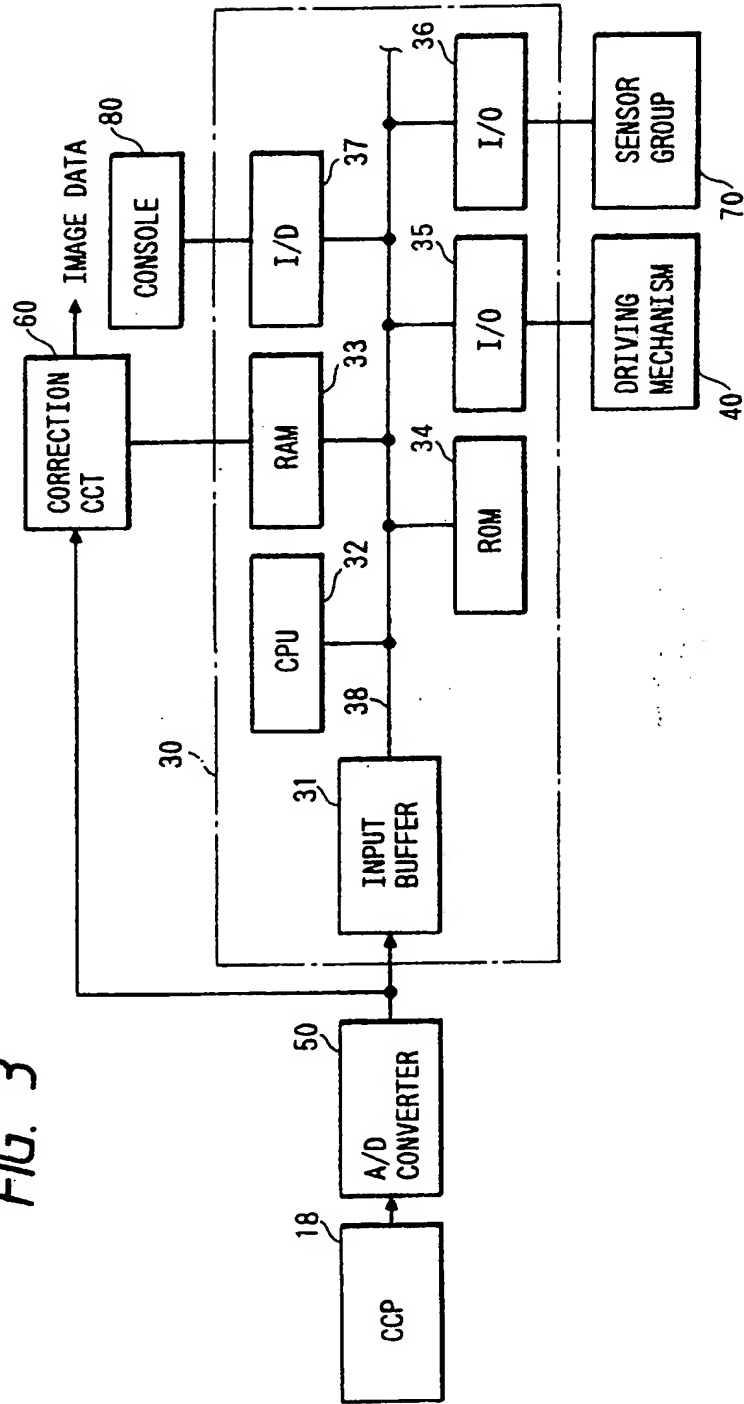


FIG. 4A

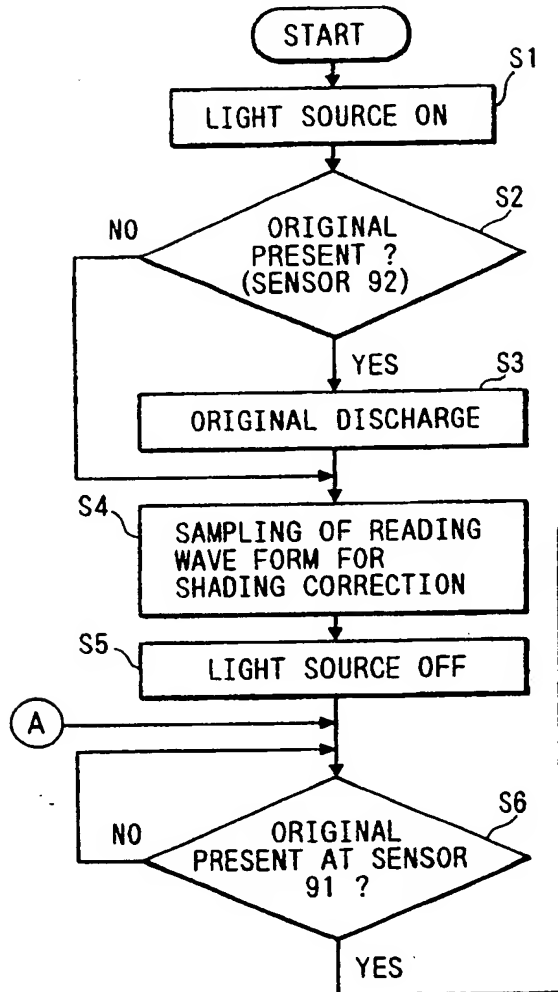


FIG. 4

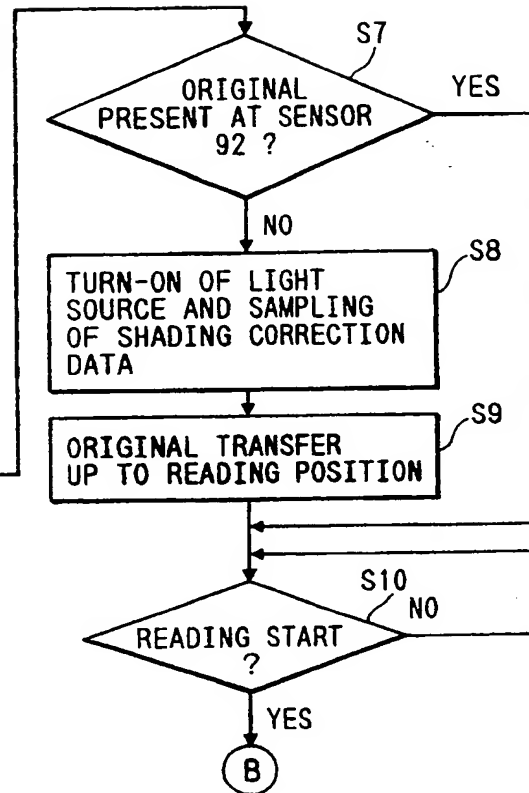
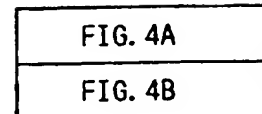


FIG. 4B

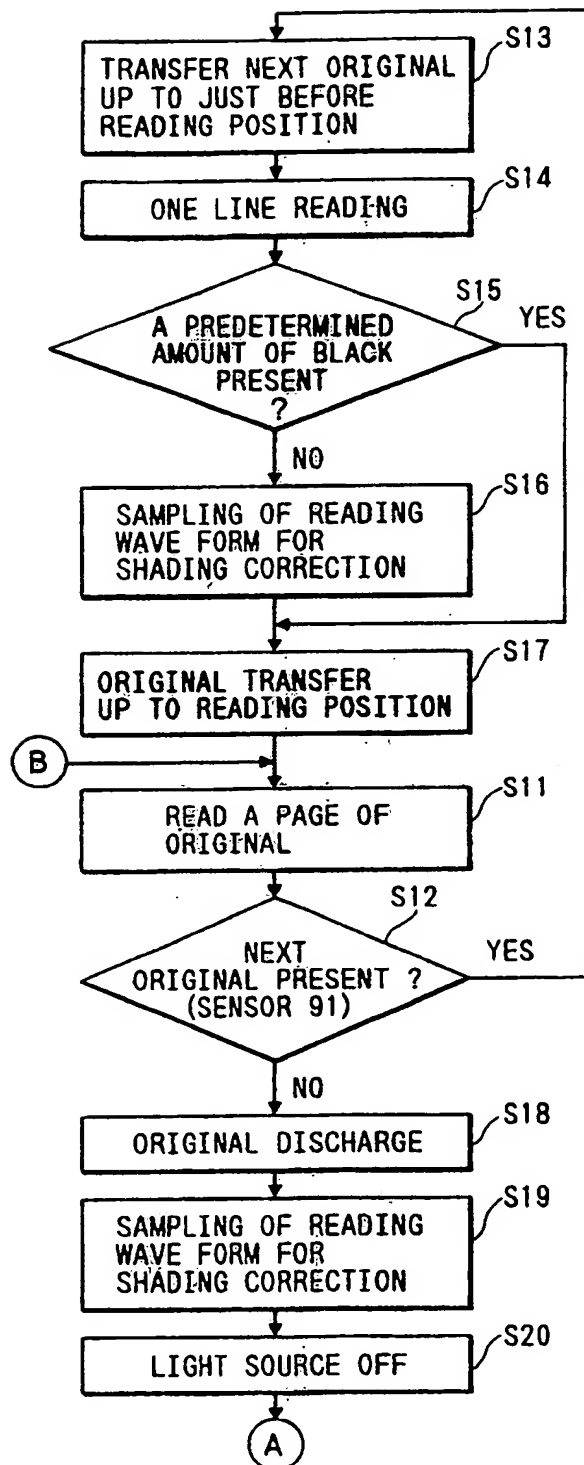


FIG. 5C

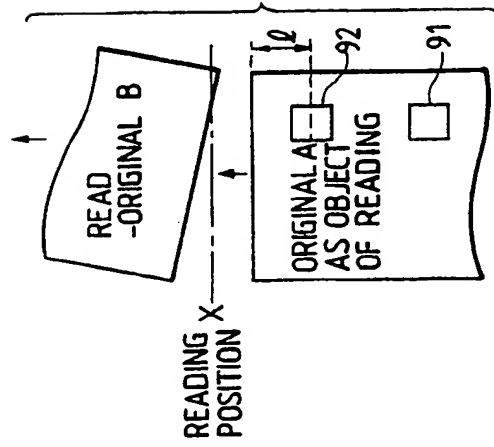


FIG. 5B

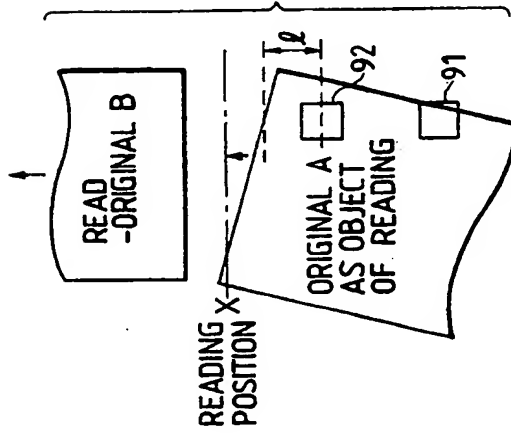


FIG. 5A

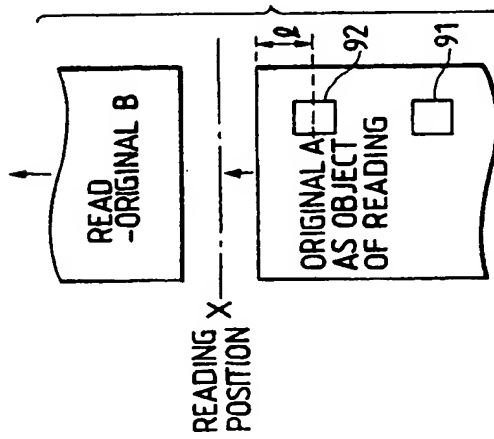


FIG. 6C



FIG. 6B

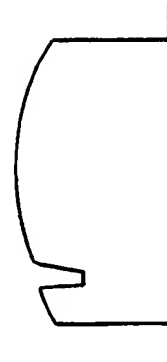
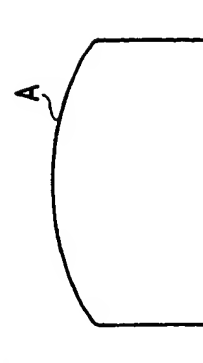


FIG. 6A





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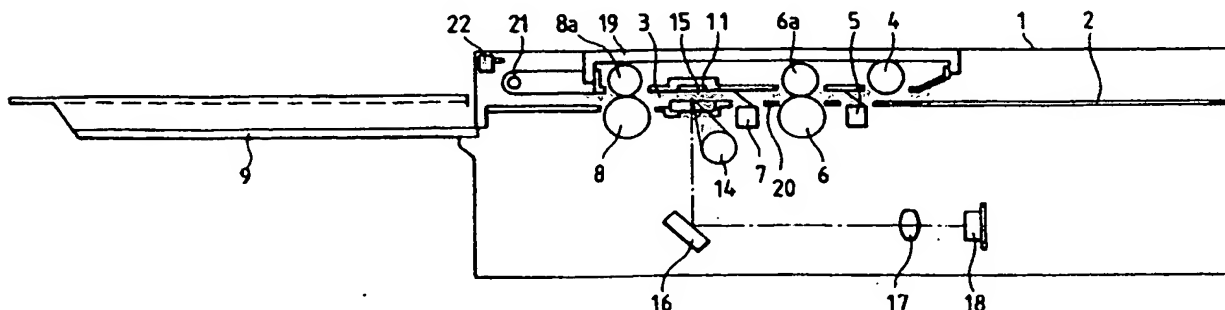
(54) **An Image reading apparatus.**

(57) There is disclosed an image reading apparatus for photoelectrically reading an image used for facsimile apparatus, digital copying machines, etc.

The image reading apparatus includes a reading unit for reading an image on an original at a reading position, a reference member provided at the read-

ing position, a memory unit for storing reference data obtained by reading the reference member with the reading unit, a discriminating unit for discriminating whether or not the original exists at the reading position and a control unit for causing the memory unit to store the reference data.

**FIG. 1**



**EP 0 451 845 A3**



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number

EP 91 10 5791

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D, A	US-A-4 870 501 (YOSHIDA)  " abstract; figure 1 " " column 4, line 63 - column 5, line 28 " " column 8, line 26 - line 60 " ---	1, 5, 7, 8, 12-14, 17, 19	H04N1/00 H04N1/40 H04N1/04
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 051 (E-881)30 January 1990 & JP-A-1 277 054 ( CANON ) 7 November 1989 " abstract "	1, 3-5, 8, 10-12, 14, 15, 17	
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 265 (E-637)23 July 1988 & JP-A-63 048 960 ( CANON ) 1 March 1988 " abstract "	1, 5, 7, 8, 12-14, 17, 19	
A	PATENT ABSTRACTS OF JAPAN vol. 5, no. 153 (E-76)26 September 1981 & JP-A-56 084 066 ( TOKYO SHIBAURA DENKI ) 9 July 1981 " abstract "	4, 11, 15	
A	PATENT ABSTRACTS OF JAPAN vol. 10, no. 233 (E-427)13 August 1986 & JP-A-61 065 660 ( CANON ) 4 April 1986 " abstract "	1, 6, 8, 14, 18	
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 13 JULY 1992	Examiner JONSSON B.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document  T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... @ : member of the same patent family, corresponding document			



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